MAR 18 1989

FLOOD INSURANCE STUDY

TOWNSHIP OF GARFIELD, MICHIGAN
NEWAYGO COUNTY

MAY 4, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER 260469

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY

TOWNSHIP OF GARFIELD,
NEWAYGO COUNTY,
MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and supersedes a previous Flood Insurance Rate Map for the Township of Garfield, Newaygo County, Michigan (Reference 1). This information will be used by the community to update existing floodplain regulations as part of the regular phase of the National Flood Insurance Program. The information will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared originally for purposes other than the National Flood Insurance Program. The data were identified as applicable at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. The Federal Emergency Management Agency (FEMA) performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the National Flood Insurance Program. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, FEMA, Chicago, Illinois, for consideration for revision of this study.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were obtained from the Michigan Department of Natural Resources (MDNR) report titled "Muskegon River Floodplain Study" (Reference 2).

1.3 Coordination

On June 2, 1988, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Garfield, Newaygo County, Michigan. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected based on the extent and validity of available existing hydrologic and hydraulic data.

Flooding caused by overflow of the Muskegon River was studied in detail.

2.2 Community Description

The Township of Garfield is in southwestern Newaygo County, Michigan, and is bordered by the Township of Sherman on the north, the Township of Ashland on the south, the Township of Brooks and the City of Newaygo on the east, and the Township of Sheridan on the west. The community is served by State Highway 82, which runs east and west through the center of the township. The 1980 population of the Township of Garfield was reported to be 1,822 (Reference 3).

Some development exists within the floodplain of the Muskegon River, especially in the areas known as Anderson Flats and Old Womans Bend.

2.3 Principal Flood Problems

On September 12, 1986, a flood with a discharge of 23,100 cubic feet per second (cfs) reached an elevation of 645.39 feet National Geodetic Vertical Datum of 1929 (NGVD) on the Muskegon River and caused damage to numerous structures along the river. Flood problems result from the severe meandering of the river, which causes the shifting of a large percentage of the flow between the channel and the overbanks. Past floods recorded at the City of Newaygo (References 4 and 5) are shown below.

YEARS	GAGE HEIGHT (FEET)	ELEVATION (NGVD)	DISCHARGE (CFS)
1986	19.56	645.39	23,100
1913	*	*	14,950
1912	*	*	13,400
1945	53.76**	639.59	11,600
1976	13.37	639.20	10,800
1957	52.83**	638.66	10,000
1919	*	*	9,880
1950	52.70**	638.53	9,830
1975	12.75	638.58	9,800
1959	52.65**	638.48	9,750

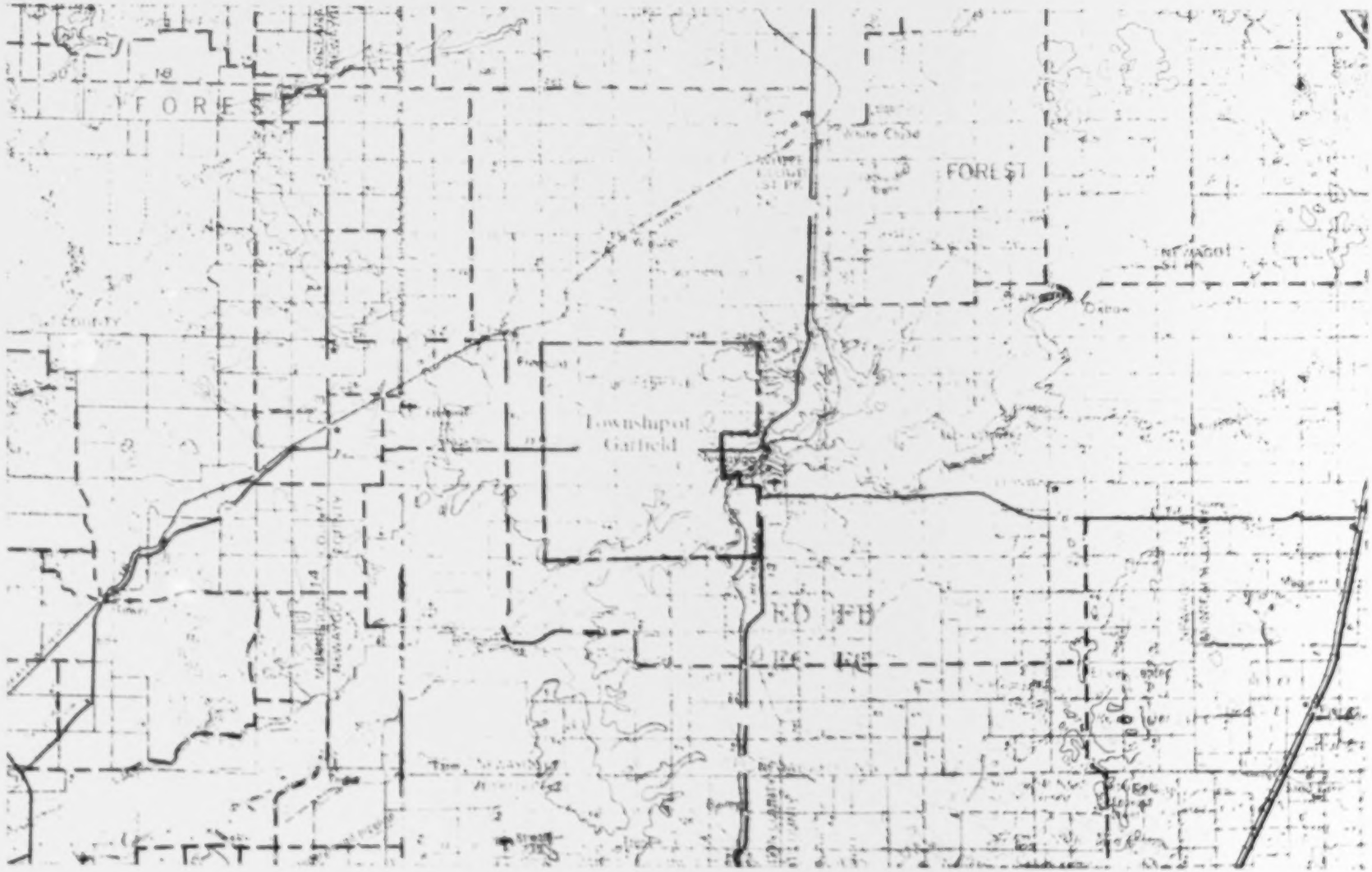


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF GARFIELD, MI
(NEWAYGO CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

* Gaging station located at Croton Dam, stage not recorded at Newaygo

** from 1939 to 1963, datum of gaging station was at 585.83 NGVD, 40.00 feet lower than existing datum of gage

2.4 Flood Protection Measures

Flood protection measures are not known to exist within the study area.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that is expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

The September 1986 flood was the flood of record at the Newaygo gage station; the peak discharge of 23,100 cfs for this event exceeded the 1913 flood of record (14,950 cfs) by about 55 percent. As a result of that significant flood, the hydrologic analysis was revised to yield a 100-year discharge of 18,800 cfs on the Muskegon River at the City of Newaygo. The discharge value of 18,800 cfs was used to determine peak discharge-frequency relationships for this study.

The peak discharge-drainage area relationship for the 100-year flood of the Muskegon River in the community is shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 100-YEAR
MUSKEGON RIVER		
at City of Newaygo	2,350	18,800

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Bridge and cross-section information was originally obtained by the MDNR in July 1971, and was revised based on another field survey in December 1977.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and on the Flood Insurance Rate Map.

Hydraulic calculations were developed using the HEC-2 computer program (Reference 6). Starting water-surface elevations were determined using stage-discharge relationships based on the slope-area method.

A 308 report prepared by the U.S. Army Corps of Engineers (Reference 7) was used to estimate flood elevations. The report contains high-water marks from the 1913 flood that were combined with the pre-1986 record flood discharge value of 14,950 cfs in the hydraulic analysis to provide a comparison to the record 1986 flood.

Roughness coefficients (Manning's "n") were determined based on field inspection of the study reaches. Due to severe meandering of the Muskegon River, higher roughness coefficients were used in the analysis.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the NGVD.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year

floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:25000 with a contour interval of 3 meters (Reference 8).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In Michigan though, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public Acts of 1968 (Reference 9), encroachment in the floodplain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the MDNR, Land and Water Resources Division, a floodway having no more than a 0.1-foot surcharge has been delineated for this study. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are shown in Table 2, Floodway Data. The computed floodways are shown on

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
MUSKEGON RIVER								
A	28,205	610	6217	3.0	626.7	626.7	626.8	0.1
B	31,630	550	6073	3.1	628.1	628.1	628.2	0.1
C	35,390	770	8272	2.3	629.5	629.5	629.6	0.1
D	37,540	955	10,298	1.8	630.4	630.4	630.5	0.1
E	42,040	495	5311	3.5	631.3	631.3	631.4	0.1
F	44,690	594	7155	2.6	632.6	632.6	632.7	0.1
G	46,640	425	5050	3.7	633.4	633.4	633.5	0.1
H	48,490	397	6140	3.1	634.4	634.4	634.5	0.1
I	51,715	1076	8825	2.1	635.3	635.3	635.4	0.1
J	53,470	1430	16,093	1.2	635.8	635.8	635.9	0.1
K	55,570	900	7279	2.6	636.0	636.0	636.1	0.1
L	56,570	1588	12,303	1.5	636.5	636.5	636.6	0.1
M	60,870	627	4844	3.9	637.1	637.1	637.2	0.1
N	63,095	427	5683	3.3	638.6	638.6	638.7	0.1
O	65,965	450	5080	3.7	639.6	639.6	639.7	0.1
P	68,465	410	5163	3.6	640.6	640.6	640.7	0.1
Q	71,345	393[2]	5344	3.5	641.4	641.4	641.5	0.1
R	72,345	303[2]	4412	4.3	641.7	641.7	641.8	0.1
S	72,945	319[2]	4532	4.1	641.9	641.9	642.0	0.1

[1]FEET ABOVE LIMIT OF DETAILED STUDY (3000 FEET DOWNSTREAM FROM WARNER AVENUE)
[2]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF GARFIELD, MI
(NEWAYGO CO.)

FLOODWAY DATA

MUSKEGON RIVER

the Flood Insurance Rate Map. In cases where the floodway and the 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway for the Muskegon River lie outside the corporate limits.

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplain will not cause an increase in the base flood elevations greater than the state's allowable surcharge at any point within the community.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than the state's allowable surcharge at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

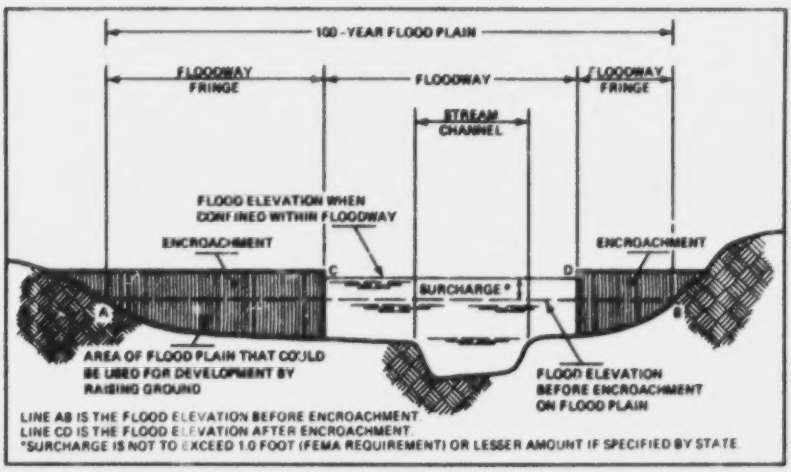

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Flood Insurance Studies in progress for the Townships of Bridgeton, Brooks, and Ashland, Michigan (References 10-12) are in agreement with this study.

This Flood Insurance Study supersedes the previously printed Flood Insurance Rate Map for the Township of Garfield (Reference 1).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 175 West Jackson Boulevard, 4th Floor, Chicago, Illinois 60604.

9.0 REFERENCES AND BIBLIOGRAPHY

1. Federal Emergency Management Agency, Flood Insurance Rate Map, Township of Garfield, Newaygo County, Michigan, September 1986.

2. Michigan Department of Natural Resources, Engineering Water Management Division, Muskegon River Floodplain Study, Lansing, Michigan, January 1987.

3. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Michigan, Washington, D.C., January 1982.

4. U.S. Geological Survey, Water Supply Paper 1677, Magnitude and Frequency of Floods in the United States, Part 4, St. Lawrence River Basin, Washington, D.C., 1965.

5. ————, Water Resources Data, Through Water Year 1985, Lansing, Michigan, 1986.

6. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, April 1984.

7. War Department, Muskegon River, Michigan, 72nd Congress, Document No. 143, Washington, D.C., 1931.

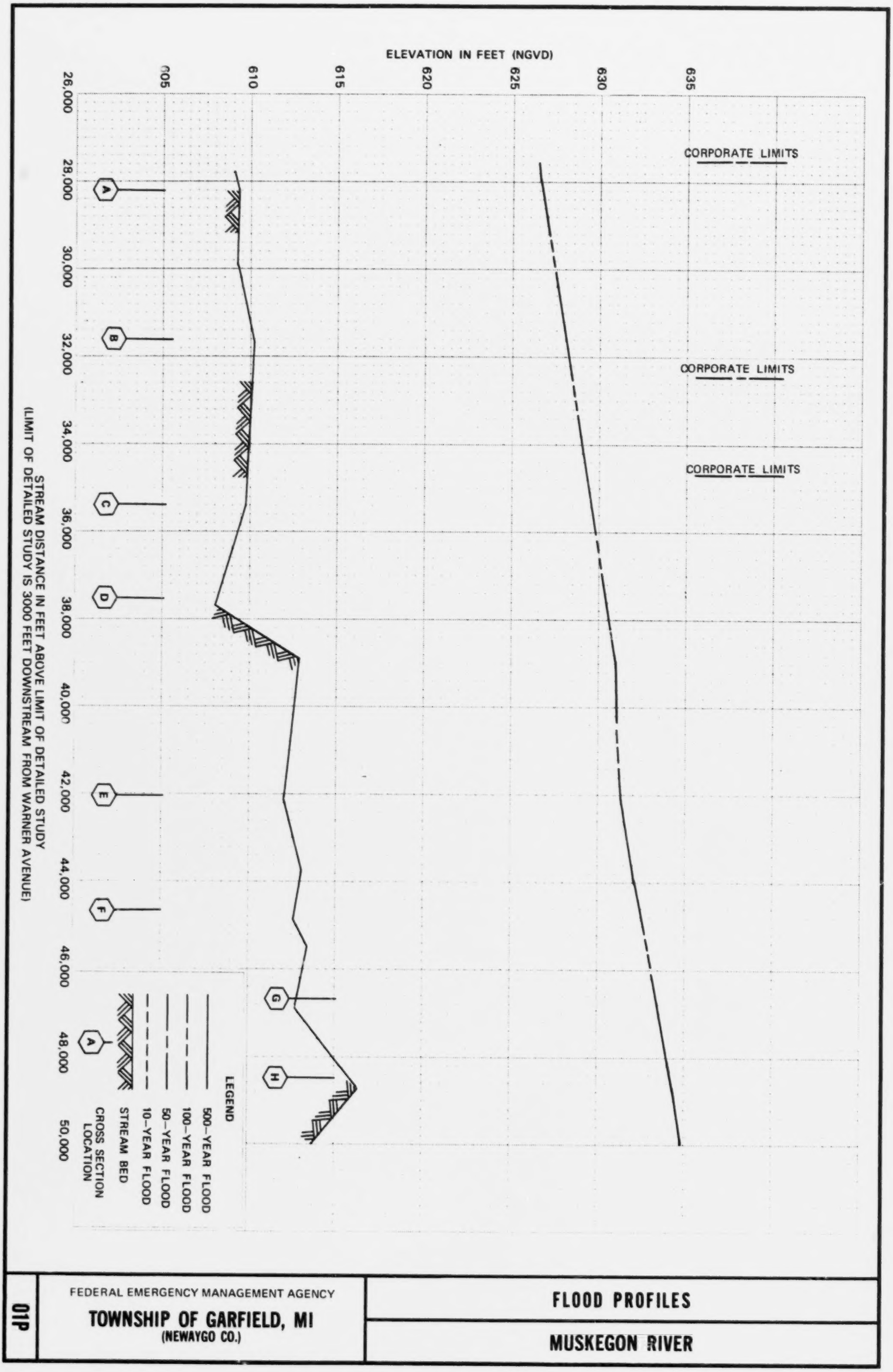
8. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:25000, Contour Interval 3 Meters: Bridgeton, Michigan, provisional 1985; Fremont, Michigan, provisional 1985; Newaygo, Michigan, provisional 1985.

9. State of Michigan, Floodplain Control Act of 1968, Act 245, P.A. 1929 as amended by Act 167, P.A. 1968, Michigan Water Resources Commission, Lansing, Michigan, 1968.

10. Federal Emergency Management Agency, Flood Insurance Study, Township of Bridgeton, Newaygo County, Michigan, in progress.

11. ————, Flood Insurance Study, Township of Brooks, Newaygo County, Michigan, in progress.

12. ————, Flood Insurance Study, Township of Ashland, Newaygo County, Michigan, in progress.



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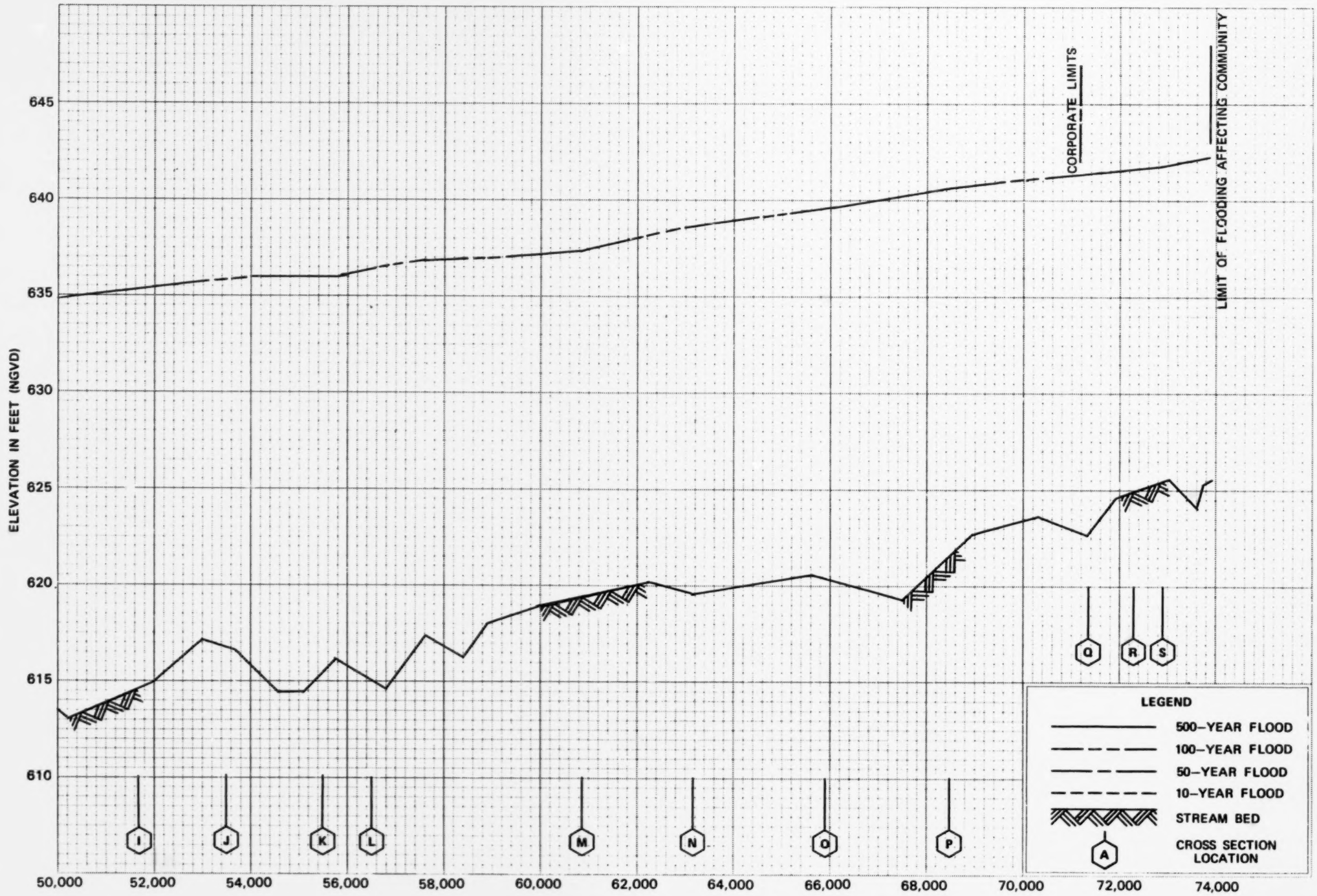
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF GARFIELD, MI
(NEWAYGO CO.)

FLOOD PROFILES

MUSKEGON RIVER



FLOOD PROFILES

MUSKEGON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF GARFIELD, MI
(NEWAYGO CO.)

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